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BALLISTIC MISSILE PROLIFERATION

by Marie-France Desjardins

INTRODUCTION

At a time when the superpower arms race has turned a new corner and the prospects of reversal seem real, the international community has awakened to the growing dangers associated with a long unabated arms competition: the proliferation of ballistic missiles.

Although ballistic missiles have been transferred to Third World countries since the early 1960s, widespread concern over their presence throughout the world is quite recent and is the result of a number of developments.

In the eight year war between Iran and Iraq, an estimated 1,000 ballistic missiles were fired, the largest number since World War II. In 1988, Saudi Arabia acquired Chinese ballistic missiles with a range of more than 2,500 kilometres. This confirmed a willingness on the part of some suppliers to transfer ever more sophisticated weapon systems, regardless of the potential implications for strategic stability in the regions affected. By the end of the 1980s, the scope of missile acquisition and production efforts throughout the world became better known. While some 25 Third World countries have been identified as pursuing an advanced missile capability, many are also entangled in political and military tensions with other states. In addition, some are seeking a nuclear weapons capability, and several possess a chemical warfare capability. This has raised the concern that some states may view ballistic missiles as an effective means of delivering weapons of mass destruction, including nuclear, chemical and biological weapons, and that ballistic missiles may in fact be used in this fashion.

The only multilateral step to control the proliferation of ballistic missiles came about in 1987 when seven leading industrial nations adopted a common set of guidelines on exports of missile equipment and technology. Many observers contend, however, that this belated attempt to curb missile proliferation may be too little, too late.

BALLISTIC MISSILES

Although the term is used frequently in arms control and defence literature, there is no universally accepted, precise definition of "ballistic missile". However, the common elements found in the many definitions are; it is an unmanned, self-propelled vehicle which descends to its target in a ballistic trajectory: that is, a trajectory in which the missile's fall to earth is affected only by gravitational and atmospheric forces. Ballistic missiles are powered by rocket engines and those which are long-range pass through outer space. Many ballistic missiles are guided, and most have a range exceeding 40 km. These missiles can carry a payload of conventional high explosives, chemical or biological agents, or nuclear explosives.

There are at least ten types of ballistic missiles in service today, and more than twice this number (whether missiles of new generations, modified systems or missiles of a different type) are being actively researched by some 15 countries. The technical characteristics of these systems vary greatly. The distance missiles can travel ranges from as low as 40 km (below that range they are usually classified as artillery rockets), to more than 2,000 km.[1] The same wide difference exists when comparing missile accuracy. Missile accuracy is measured by 'circular error probable' or CEP.[2] The missiles being acquired in the Third World vary from a

CEP as precise as 300 m or as imprecise as 4,000 m. It is much the same varied story with payloads, which range from approximately 100 kg to more than 2,000 kg.

THE ATTRACTION OF BALLISTIC MISSILES

For powers seeking to enhance their military capabilities, ballistic missiles are attractive for three main reasons: they can travel great distances at high speed; they can be equipped with warheads of great lethality; and, they can be guided.

Because of their speed and range, ballistic missiles provide the capability to penetrate enemy defences with little warning. Equipped with warheads of mass destruction, they can enable their possessor to deliver an initial disarming blow. Guidance and control systems direct the most sophisticated ballistic missiles to their target with considerable precision. Thus, as William Webster, Director of the Central Intelligence Agency said before the US Congress, "Ballistic missiles convey important new political and military status to those who acquire them."[3]

THE ACQUISITION OF BALLISTIC MISSILES

The question of exactly which Third World states are involved in missile acquisition has yet to be answered with certainty. Some reports suggest that at least 25 states are in the running, of which no less than 17 may already have systems deployed. According to US estimates, 15 states will have the capability to produce their own missiles before the end of the decade.

There are several means by which a state can acquire ballistic missiles. One is simply to purchase complete systems. Another is to modify existing systems, or to design and/or build complete systems or key component technologies. Some states have converted space programmes designed originally for peaceful uses to the development of military missiles. Sometimes, one or more of these methods are combined.

The purchase of large artillery rockets or small ballistic missiles is not difficult. The transfer of such systems, especially on the part of the superpowers, has been routine for the last thirty years. And now, following the lead of their suppliers, many recipient states have shown their willingness to re-transfer imported missiles.

Modification or replication of transferred systems is another way for states to enlarge, or upgrade to their own specifications, their missile arsenal. Many countries are following this route. For example, it is believed that South Korea has converted the US surface-to-air Nike Hercules missile into a surface-to-surface system, and is now producing it domestically. Iraq is believed to be constructing its own extended-range version of the Soviet Scud-B using parts of other Scud missiles.

A nation dedicated to having a ballistic missile programme can try to design and build its own system. This route, however, faces many hurdles. For example, a state would require a very high level of know-how in the design, manufacture and production of propulsion, and guidance and control systems. Despite this, some countries have already begun work on indigenous systems, often by copying others' systems, by using others' subsystems, or through a number of cooperative means with other states, including receiving technical or financial assistance.

A space programme can be used for the production of military missiles. Space programmes often begin with the development of sounding rockets, and are usually followed by space launch vehicles (SLVs). While sounding rockets are usually fired straight into the atmosphere with very unsophisticated guidance systems, SLVs are much more complex and bear many resemblances (in the propulsion and guidance systems, for instance) to ballistic missiles. In the past, many countries have benefitted from international cooperation for the development of experimental sounding rockets, gaining expertise which can be put towards the development of a missile programme.

THE MISSILE RACE

A complete, worldwide, nation-by-nation survey of ballistic missile programmes is beyond the scope of this paper. This is particularly so since information about ballistic missiles is still very spotty and often contradictory. In fact, as one observer has pointed out, "Rarely if ever since the late 1950s has the international community faced a major arms control and security issue with so little reliable information."[4] Bearing this in mind, the following description of some developments in a selected number of states is only intended to provide an overview of the problem missile proliferation poses today, and in the near future. This information, unless otherwise stated, is drawn from one or more of the following sources: the 1989 and 1990 editions of the *SIPRI Yearbook;* a 1989 *CRS Report for Congress* by the US Congressional Research Service; and, an article which appeared in *Survival*, the journal of the International Institute for Strategic Studies.[5]

MIDDLE EAST

Of all the regions where ballistic missiles are being introduced today, the Middle East is by far the most worrisome. Seven states are actively pursuing the acquisition of various systems. In fact, the introduction of missiles to the region is becoming so widespread that no capital from Northern Africa to the Persian Gulf, to the Fertile Crescent, is beyond the reach of missile attack by a rival state.

The Middle East is also the focus of attention because it has recently been the scene of the first extensive use of ballistic missiles since the Second World War, namely, the war between Iran and Iraq. Furthermore, since many of those missiles were targeted against enemy cities, the precedent has been set for their use against civilian populations.

Israel

Israel possesses the most advanced ballistic missile technology in the region. Its domestically produced ballistic missiles are based on a system developed with the help of France in the 1960s, and are now believed to be nuclear-capable, if not already nuclear-armed.

The Jericho I missile, with a range of approximately 500 km, is said to be similar in size and performance to the US Pershing I.[6] The Jericho II, reportedly first tested in 1987, is believed to have a better guidance system, a more impressive payload, and a greater range than the previous model. Reports suggest that Israel may possess as many as 50 Jericho Is and up to 100 Jericho IIs.

Following Israel's launch of a domestic satellite in 1988, Tel Aviv has been credited with the ability to deploy a missile capable of reaching targets approximately 1,500 km away. This brings within reach Soviet military bases on the Black Sea, and Moscow has already raised its concerns about such a development.

Israel's missile technology programme may have served as a *quid pro quo* for access to South African uranium. According to US sources, the missile technology of the Jericho II may have been transferred to South Africa in exchange for uranium and access to a missile test site.[7]

Syria

Syria has a diversified missile force, although it is highly dependent on foreign imports. In addition to its Soviet-made large artillery rocket, the Frog-7, Syria has obtained from Moscow numerous SS-21 and Scud-B missiles. Although the Frog-7 is an old system with a limited range of 70 km, reports suggest that Damascus may have developed a chemical warhead to fit the missile. It is also rumoured that Syria is attempting to do the same for the longer range (300 km), though less accurate, Scud-B missile, as well as for the highly accurate, but shorter range (120 km), SS-21 Scarab.

There are reports that Syria may have approached China for its M-9 missile, believed to be a land-based system with a range of 600 km. Although the M-series is not yet fully developed, some reports suggest Syria's hopes of acquiring any may have been dashed by US pressures on Beijing.

Iraq

Iraq also possesses a significant missile capability. In addition to its Frog-7 and hundreds of Scud-B missiles, many of which were fired at Iran during the Gulf War, Iraq has a dedicated missile research and development programme and has cooperated with other countries in the development of new missiles.

Using its own resources, Baghdad has twice upgraded and extended the range of its Scud-B missile. In August 1987, the Iraqi government announced having tested a 650 km land-based missile called the al-Hussein.[8] In April 1988, Baghdad announced the successful test of a 900 km range missile, named al-Abbas.

Iraq is believed to have invested at least $3 billion in missile development and production. It also provided partial financing for the Argentinian-led Condor project. Egypt was also involved in this project, the aim of which was to develop a missile of 1,000 km range. Due to US pressure, however, Egypt withdrew from the project and Argentina cancelled its participation because of cost.[9] According to some analysts, Iraq's interest was to equip such a missile with nuclear warheads.

In December 1989, to the surprise of many experts, Iraq successfully launched a three-stage, 48 ton rocket into the atmosphere. This rocket could give Baghdad the potential to place a satellite into low orbit, or produce a missile capable of delivering warheads thousands of kilometres away.

Combined with Iraq's missile programme is its attempts to acquire a nuclear weapons capability. Even though Israel slowed the Iraqi nuclear programme when it bombed the Osiraq nuclear reactor in 1981, many sources suggest that Iraq is trying to use a network of companies in Europe to procure the equipment and expertise to produce fissionable material. Concerns about Iraq's nuclear ambitions were renewed in March 1990, when electronic devices that can be used to trigger nuclear bombs were seized in England before being sent illegally to Baghdad.

Although Iraq made use of chemical weapons during its war with Iran, there is no confirmation that ballistic missiles delivered them. In April 1990, however, Iraq's President Saddam Hussein said that his country has chemical weapons and announced it would use them if threatened by nuclear weapons — referring to Israel and its nuclear weapons capability. This was followed in September 1990 by a report that Iraq successfully tested a chemical warhead on a ballistic missile in 1989.[10]

Iran

Like Iraq, Iran possesses a large inventory of ballistic missiles and made extensive use of them in the Gulf War. In addition to its Scud missiles, there are

reports that Iran is now mass producing an indigenous tactical artillery rocket named Oghab. Teheran has also allegedly received assistance from China for the production of the guided missile known as the Iran-130. Like Syria, it may also have tried to obtain from the Chinese the more capable M-9 missile.

While Iran is believed to be many years away from a nuclear weapons capability, it made limited use of chemical weapons during the Gulf War, and may be close to developing chemical warheads for its missiles. Iran may also be seeking a biological warfare capability. In 1989, it was disclosed that in December 1988, Iran tried to purchase toxins in Canada and the Netherlands, probably for a biological weapons research programme.[11]

Egypt

Egypt's missile inventory includes Frog-7 and Scud-B missiles. Egypt has also cooperated with a number of countries to improve and enlarge its missile arsenal: with Argentina and Iraq on the now abandoned Condor missile programme (or Badr-2000 as it was called by Cairo); with North Korea for the production of an upgraded Scud-B system; and, with Iraq for the production of an unguided rocket of 80 km range called the Sakr-80, which apparently Cairo already possesses and may have deployed.

Saudi Arabia

Saudi Arabia's acquisition of Chinese CSS-2 missiles (also known as DF-3) was disclosed in March 1988. The concern over this transfer lies in the capability of the missile. Indeed, although the CSS-2 reportedly has poor accuracy, its range may well be in excess of some 2,500 km (estimates vary between 2,200 and 3,500 km). Apart from its range, the CSS-2 raises concerns precisely because it is inaccurate. This inaccuracy suggests that the missile might not be used with conventional weapons. Conventional weapons require pin-point delivery in order to destroy their target, whereas weapons of mass destruction do not. It should also be noted that the Chinese version of the CSS-2 has been designed to carry nuclear weapons.

In an effort to respond to these concerns, however, Riyadh signed the 1968 Non-Proliferation Treaty (NPT) thus committing itself not to acquire nuclear weapons. Saudi Arabia has also promised not to use the missiles with chemical weapons.

Libya

Tripoli possesses an impressive inventory of Frog-7 and Scud-B missiles acquired from the Soviet Union in the 1970s. Since then, Libyan leader Muammar al-Qaddafi has tried to obtain more powerful systems, including, the Chinese CSS-2 missile, the Soviet SS-23, and a yet to be developed 1,000 km range missile from Brazil. It has also been reported that Libya sought assistance from a West German firm, Otrag, to develop a 300 to 500 km range rocket.

Even though Libya has signed the Non-Proliferation Treaty, it's nuclear ambitions have never been completely dismissed. In 1981, senior Libyan officials held meetings with a former CIA employee to acquire nuclear weapons on the black market.[12] In addition, Libya's efforts to acquire a chemical weapons capability were well publicized in the late 1980s when it began operations at a chemical plant at Rabta.

Not only has Libya acquired ballistic missiles, it has shown a willingness to use them. In 1986, in retaliation for the US raid on Libya, it launched Scud-B missiles against the US Coast Guard station on the Italian island of Lampedusea: the missiles fell short of the target.[13]

ASIA

The ballistic missile competition in Asia is taking on alarming proportions. The dominant actors include India, Pakistan, North Korea, South Korea and Taiwan.

India

India's missile programme is believed to derive from its space programme which began in the late 1960s, and is now one of the most advanced in the world. In 1980, India became the seventh nation in the world to place a satellite in low orbit with an indigenous launch vehicle.

The two most important Indian-developed missiles are the Prithvi and the Agni. While the Prithvi is believed to be very accurate, and capable of carrying a nuclear weapon over a range of some 250 km, little is known about the Agni. It is suspected, however, that upon completion, it might have 10 times the range of the Prithvi.

India's ability to place a satellite in orbit suggests it has mastered most of the hurdles of developing an intermediate-range ballistic missile. Furthermore, because India is already working on a geostationary launch vehicle (GSLV), the possibility that it could develop an intercontinental-range ballistic missile cannot be dismissed. Long-range missiles would allow India to strike targets in China, with which it has clashed in the past.

India's missile programme raises particular concerns because it tested a nuclear device in 1974, and has refused to sign the Non-Proliferation Treaty. Moreover, India has fought three wars with Pakistan. The two nations have since come close to a conflict on at least three other occasions, the most recent in the summer of 1990.

Pakistan

In 1988, Pakistan announced that it had tested two types of indigenously developed ballistic missiles. In contrast, unconfirmed reports suggest that Pakistan has developed two versions of a single missile named Shadoz (or King Hawk) with a range of 300 km. It was probably produced with China's assistance.

Pakistan, like India, is not a signatory to the NPT, and is widely believed to have all the components and know-how to build nuclear weapons, as well as the motivation to do so.

North Korea and South Korea

Both North and South Korea are producing modified versions of systems acquired some years ago from allied states. North Korea is producing and exporting a modified version of the Scud-B missile, reportedly acquired from Egypt. Pyongyang is also probably helping Egypt and Iran build their own missile factories. Although North Korea has signed the Non-Proliferation Treaty, it has not yet completed its negotiations with the International Atomic Energy Agency for the application of international safeguards on its nuclear programme. Furthermore, North Korea is suspected of completing work on an undeclared nuclear facility, thus giving credence to the likelihood of a nuclear weapons programme. It is also reported that Pyongyang could have the technical expertise to produce a chemical warhead for its Scud-B missiles.

Like its rival North Korea, South Korea indigenously produces a surface-to-surface missile based on foreign technology. The South Korean missile is thought to be a modified surface-to-air Nike-Hercules missile of US origin. Seoul has apparently upgraded its range to approximately 200 km, and made it a surface-to-surface missile. With that range, it could strike North Korea's capital, Pyongyang.

Taiwan

The missile programme of Taiwan is allegedly based on modifications made to imported systems. The missile copied is the US Lance missile, believed to have been transferred to Taipei by Israel. The Ching Fen (or Green Bee as it is also known) is believed to have a range of 100 km, and may now be serving as the basis of research on a more powerful system; the 1,000 km range Sky Horse missile. Such a range is sufficient to reach mainland China.

SOUTH AMERICA

In South America, the two main competitors in missile development are Argentina and Brazil. While tensions between the two countries have decreased significantly in recent years, their motivation for developing ballistic missiles is as real as in other regions. It is likely, however, that Argentina and Brazil are driven mainly by the attractiveness of playing a supplier role.

Argentina

Argentina has had a space sounding rocket programme since the 1960s, but it was only after the Falkland/Malvinas Islands conflict in 1982 that it began work on its Condor ballistic missile. According to numerous reports, the Condor II was to have a range of 1,000 km — enough to reach the Falkland Islands — and, by the reported size of its payload, could have been equipped with nuclear or chemical warheads. The programme, however, was abandoned in the spring of 1990. Other participants in this project were Iraq and Egypt. Argentina has not signed the Non-Proliferation Treaty.

Brazil

Brazil has a more ambitious space programme than Argentina and its missiles are believed to be derived from its Sonda experimental rockets. Brazil's research and development programme is very extensive, including at least six types of missiles developed by two companies, Orbita and Avibras. From Orbita, the MB-EE 150 is believed to be capable of carrying a 500 kg payload (sufficient for a nuclear warhead). Others in this family of missiles include the MB-EE 350, 600 and 1000. All are at an unknown stage of development.

Brazil's other missile manufacturer, Avibras, is working on a number of competing systems called the SS-150, SS-300 and SS-1000 (the latter with a range of some 1,200 km). Reports indicate that the SS-300 was the furthest developed but was abandoned because of lack of funds.

REASONS FOR CONCERN

The deadliness of ballistic missiles cannot be overstated, especially when equipped with weapons of mass destruction. Compounding the anxiety, however, is the fact that ballistic missiles are being introduced to regions of great tensions or existing conflicts.

Because ballistic missiles can travel long distances at a very high speed, they can easily breach enemy defences. Consequently, all parties facing a rival with missiles become highly vulnerable to a surprise attack. Missiles, combined with weapons of mass destruction, dramatically increase uncertainty, particularly in time of crisis. Any highly urbanized state is especially vulnerable to first strike and attack with such weapons.

Such a situation can, in turn, encourage dangerous responses. Because most countries are likely to possess

only a handful of missiles — missiles which could be destroyed in an initial attack — there is, during a time of crisis, a strong incentive to use them quickly or lose them. Faced with such a choice, a state may opt for a strategy of launch-on-warning; i.e. striking at the first warning of an impending attack. Considering that ballistic missiles cannot be recalled, this strategy dramatically increases the risk of accidental war, particularly since most smaller states do not possess elaborate systems to detect false warnings.

Pre-emptive strikes against rival ballistic missiles, particularly if these missiles are few and vulnerable, may also become a compelling option in time of crisis. This too carries the potential for catastrophe. All nuclear weapons acquisition programmes, and most chemical programmes in the Third World are pursued clandestinely. In the absence of open doctrine and strategy relating to the use of these weapons, a pre-emptive strike might be interpreted as the beginning of a full-fledged attack, demanding an appropriate response.

The presence of advanced, technological weapons in volatile regions can also contribute to the initiation of preventive strikes. In 1981, when the Osiraq nuclear reactor was close to completion, Israel chose to bomb the Iraqi facility, contending that the aim of Baghdad's nuclear programme was to produce nuclear weapons. The possibility such action might take place again, this time against a missile factory, cannot easily be discarded.

CONTROLLING THE SPREAD

The first multilateral effort to curb the spread of ballistic missiles in the Third World came in 1987. After four years of secret negotiations, Canada, France, the Federal Republic of Germany, Italy, Japan, the United Kingdom and the United States agreed on guidelines to control the export of missile equipment and technology which could contribute to a missile system capable of delivering nuclear weapons. The resulting 'Missile Technology Control Regime' (MTCR) is not a treaty, but is an agreement that the member countries will apply the guidelines nationally, through national export controls.[14]

The MTCR consists of guidelines and a technical annex, which divides missile-related equipment and technology into two categories. Category 1 lists the items of greatest sensitivity. These include: complete rocket systems — including ballistic missile systems, space launch vehicles and sounding rockets — capable of delivering at least a 500 kg payload to a range of at least 300 km; specially designed production facilities for such missile systems; individual rocket stages; re-entry vehicles; and rocket engines. The MTCR Document calls for "particular restraint" and a "strong presumption" to deny such transfer. The transfer of production facilities for the above items is not to be authorized, at least until further notice. Of Category 1 items, only this transfer of production facilities is explicitly banned.

Category 2 items, which include other subsystems and components, are to be dealt with "restraint" and, as for Category 1 items, should be considered on a case-by-case basis.

The parameters for the systems to be controlled have been chosen, according to a Canadian government brief, for a number of reasons.[15] The 300 km range threshold, for example, "corresponds to strategic distances in the most compact theatres of potential conflict where nuclear missiles might become a threat."[16] In addition, with the possible exception of the Soviet Scud-B missile, there are no large missile systems widely available in the market with a range exceeding this parameter. Many observers have suggested that the theatre of consideration for the range parameter is the Middle East.

The payload parameter is said to have been chosen because, due to a lack of technical sophistication, the nuclear weapons which might be carried by Third World missiles would exceed the 500 kg threshold; hence, the transfer of such delivery systems should not be authorized.

Apart from the Document itself, very little has been made public about the MTCR regime, except that its parties have met regularly since 1987, including Rome in 1988, London in 1989, and Ottawa in 1990. In a press release issued by the Secretary of State for External Affairs in 1987, Canada invited all countries to adhere to the MTCR guidelines. Although not highly publicized, Australia, Belgium, Luxembourg and the Netherlands have now declared their intention to do so.

Some positive results of the MTCR initiative have been reported. For instance, pressure from MTCR signatory states contributed to the collapse of the Condor project involving Argentina, Iraq and Egypt. India is another country that is believed to have been slowed in its missile quest, mainly because of its reliance on foreign components. In this regard, it should be noted that of the 17 or so Third World nations with deployed systems, only three are believed to be relatively independent of foreign imports (Israel, North Korea and Taiwan). This suggests that restrictions on sales and transfers might make a considerable difference. Despite this, critics argue that weaknesses in the regime are too serious to make it an effective tool to address the problem.

For some observers, the most significant weakness of the MTCR is that its adherents are only Western industrialized nations and two important suppliers to the Third World, the Soviet Union and China, are not

part of it. Also absent from the regime are a number of other suppliers (or potential ones) like North Korea, Israel, Argentina and Brazil.

Equally significant is the lack of verification mechanisms to ensure compliance, or the mention of any possible sanctions to be used against violators. In addition, the language of the agreement has been criticized as being too vague. Critics contend that a state can simply claim that the rocket technology it wishes to import is for civilian purposes, even if such technology has equally possible military applications. This claim alone, according to some analysts, might be sufficient to allow an exporting state to ship the technology in question. Even though the MTCR guidelines state that a supplier government must receive "appropriate assurances" that the receiving government will use the items only for the purpose stated (i.e. that the imports would not contribute to a nuclear weapons delivery system), nothing is known about the type of safeguards or 'assurances' demanded by suppliers, and even less about the effectiveness of such assurances.

As cooperation between states outside the MTCR increases, and domestic programmes continue to grow, it is evident that export restrictions alone may not suffice to reverse the trend of proliferation, and other approaches will have to be explored.

FURTHER MEASURES

MTCR

Since the MTCR remains the only multilateral effort to address missile proliferation, there is a strong consensus that it should be maintained, but strengthened. In addition to increasing its adherents, the agreement could be made into a treaty. In September 1988, Soviet Foreign Minister Edouard Shevardnadze stated that a multilateral agreement to constrain the spread of ballistic missiles should be sought in the framework of the United Nations.

Another suggestion is to increase the number of items on the regime's list, and to lower the threshold so as to include missiles other than those capable of carrying nuclear warheads. Problems relating to the language of the agreement could also be carefully reviewed, and consistent and effective measures of verification could be devised.

While missile proliferation is itself a problem, actions could be taken related to the development of warheads of mass destruction, the other half of the ballistic missile proliferation equation.

Other Proliferation

Three multilateral agreements covering acquisition, production, stockpiling or use of weapons of mass destruction are already in existence. The Non-Proliferation Treaty, which came into force in 1970, proscribes the acquisition of nuclear weapons or other explosive devices by non-nuclear weapons signatory states. While the NPT has been successful in slowing the proliferation of nuclear weapons, and is now the arms control agreement with the greatest number of signatories, it still lacks universal adherence. The absence of India, Pakistan, Argentina, Brazil and Israel is a serious threat to the non-proliferation regime. Increasing the number of adherents to the treaty and ensuring its continuation in the future, could, combined with other measures, reduce the incentive to acquire ballistic missiles.

The 1925 Geneva Protocol proscribing the use in war of asphyxiating, poisonous or other gases, and of bacteriological methods of warfare has now been signed by 125 nations. The agreement, however, does not regulate the production, stockpiling or the use of such weapons in retaliation. For the past several years, negotiations have been underway to devise a more comprehensive agreement. While important progress has been made, stumbling blocks remain. The implementation of a comprehensive agreement covering production, stockpiling and all use of chemical weapons would reduce the potential deadliness of missiles.

Acquisition of biological weapons is already proscribed under the Biological Weapons Convention (BWC) signed in 1972. Yet no verification mechanisms are attached to the agreement and parties are authorized to continue research for "defensive" purposes. Furthermore, states like Israel, Syria, Iraq and Egypt have either not joined the BWC, or have signed without taking any further actions. Here again the strengthening of the agreement would be welcomed.

Lastly, it has been suggested that one way of strengthening the new missile regime would be to deny all space or missile and rocket technology to nations that do not adhere to one, or all of the above agreements.

Diplomatic actions

A whole range of diplomatic initiatives has been proposed to deal with the missile programmes of most concern. Often made on a case-by-case basis, these proposals have been mainly US initiatives, ranging from rewards for good behaviour to sanctions of all types for violators. While the use of sanctions by the international community has often had mixed results, this option, as well as others in the diplomatic field, should be considered further. Particularly, an effort should be made to apply diplomatic pressure on a multilateral basis.

Regional measures

Since ballistic missile proliferation, as well as other types of weapons proliferation, is primarily driven by the security environment of particular regions, many

observers believe that regional arms control or arms reduction measures negotiated among the parties involved would be the most promising course of action. For example, the negotiation of a ban on ballistic missile flight tests is a potential method to curb proliferation.

More limited measures aimed at improving mutual confidence are also being explored. These include, *inter alia*, the sharing of data; notification of planned test flights; access to technical expertise and systems relating to false alarms and detection of missile launches; and, inspection visits.[17]

CONCLUSION

The seriousness of the problem of ballistic missile proliferation lies not only in the fact that ballistic missiles can be used with weapons capable of causing great destruction, but also because many of the states acquiring them are deeply involved in political and military tensions and rivalries with other states.

The need to address the missile proliferation problem has already brought to the fore an initiative to limit their spread. While an important first step, the Missile Technology Control Regime as it stands today may not be sufficient to effectively address the situation. Other options must be explored and implemented if the dangers associated with ballistic missile proliferation are to be lessened and reversed. Needless to say, much work remains to be done, particularly since the root of the problem lies in the many sources of regional competition, rivalry and conflict.

NOTES

1 Data about the range of ballistic missiles has been taken from: Aaron Karp, "Ballistic Missile Proliferation," *SIPRI Yearbook 1990: World Armaments and Disarmament*, Oxford University Press, Toronto, 1990, pp. 382-390. Data about accuracy and payloads has been taken from: Library of Congress, Congressional Research Service, "Missile Proliferation: Survey of Emerging Missile Forces," *CRS Report for Congress*, No. 88-642 F, Washington, Revised February 9, 1989, pp. 38-42.

2 CEP is calculated by the radius of a circle within which a warhead has a 50% chance of landing.

3 Quoted in "Wanted Worldwide: US Missile Technology," *The Christian Science Monitor*, 23-29 March 1989, p. 10A

4 Aaron Karp, "Ballistic Missile Proliferation in the Third World," *SIPRI Yearbook 1989: World Armament and Disarmament*, Oxford University Press, Toronto, 1989, p. 287.

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6 Duncan Lennox, "The Global Proliferation of Ballistic Missiles," *Jane's Defence Weekly*, 23 December 1989, p. 1384.

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10 Robin Wright and John Broder, "Iraqis test-fire chemical warhead," *Toronto Star*, 15 September 1990, p. 8.

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12 Leonard Spector, *Going Nuclear*, Ballinger Publishing, Cambridge, 1987, pp. 150-151.

13 Steven Zaloga, *op. cit.*, p. 1427.

14 Canada, Department of External Affairs, "Control of Transfer of Missile Technology," *Communiqué* No.69, 16 April 1987, and "Guidelines for Sensitive Missile-Relevant Transfers" and "Equipment and Technology Annex" (Attachments to *Communiqué* No. 69).

15 Canada, Department of External Affairs, "Control of Transfer of Missile Technology," *Communiqué* No. 69, 16 April 1987, and "Background Paper: Missile Technology Control Regime: Questions and Answers" (Attachment to *Communiqué*, No. 69).

16 *Ibid.*, pp. 4-5.

17 Many proposals for confidence and security building measures have been advanced by Gerald M. Steinberg. See Gerald M. Steinberg, "The Middle East in the Missile Age," *Issues in Science and Technology*, Summer 1989, pp. 35-40.

At the time of writing, Marie-France Desjardins was a Researcher at the Institute. She is currently pursuing her Ph.D at the Department of War Studies, King's College London.

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